GAO/EMD-82-69

BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Secretary Of The Interior

Actions Needed To Promote A Stable Supply Of Strategic And Critical Minerals And Materials

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The administration's April 5, 1982, program plan required by the National Materials and Minerals Policy, Research and Development Act of 1980 does not adequately address (1) what constitutes a strategic and critical mineral or material, (2) what is the magnitude of potential U.S. vulnerability, and (3) what is the proper Federal role.

GAO concludes that unless these issues are resolved, a coherent plan to reduce U.S. minerals and materials vulnerability may be difficult, if not impossible to implement, and the limited Federal funds available may not be expended in the most cost-effective manner.

GAO recommends that the Secretary of the Interior (1) clearly define the terms "strategic" and "critical," (2) establish criteria and develop a methodology to measure the magnitude of potential U.S. vulnerability, and (3) articulate how each proposed short-term action relates to long-term national goals and policies.

GAO/EMD-82-69
JUNE 3, 1982

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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

ENERGY AND MINERALS
DIVISION

B-206849

The Honorable James G. Watt
The Secretary of the Interior

Dear Mr. Secretary:

The National Materials and Minerals Policy, Research and Development Act of 1980 (P.L. 96-479) was enacted to provide a national policy for materials and minerals and to strengthen related research and production capabilities. The Executive Office of the President is implementing this policy primarily through the Cabinet Council on Natural Resources and the Environment, of which you are Chairman pro tem. The President's April 5, 1982, program plan and report to the Congress, required by the act, states that national materials policy will be coordinated through your Cabinet Council to "ensure high level consideration of important materials policy issues on a timely basis with the capability of prompt action on such issues by the President."

Concern over the uncertain availability of some minerals and materials considered essential or critical to this Nation's industrial base during peacetime, demand surges including military buildups, and mobilization for national emergencies has long been an issue associated with the need for a national nonfuel minerals and materials policy. Accordingly, Public Law 96-479 gives high priority to the issue of strategic and critical minerals and materials. However, the President's program plan, while identifying measures to diminish U.S. minerals and materials vulnerability, does not adequately address the fundamental, rudimentary issues of (1) what constitutes a strategic and critical mineral or material, (2) what is the magnitude of potential U.S. vulnerability in a given nonfuel mineral or material market, and (3) what is the proper Federal role, including the benefits and costs associated with various mitigating alternatives. Unless these issues are resolved, a coherent plan to reduce U.S. minerals and materials vulnerability may be difficult, if not impossible, to implement, and the limited Federal funds available may not be expended in the most cost-effective manner.

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The President's program plan addresses general solutions for reducing increasing U.S. dependency on foreign sources for strategic and critical minerals and materials, including (1) long-term, high-risk research and development with potential wide generic application to materials problems and increased productivity; (2) strategic and critical minerals impact analyses on proposed future congressional land withdrawals; and (3) congressional approval to dispose of excess materials in the National Defense Stockpile and to acquire necessary stockpile materials. Yet, a growing consensus of opinion is that assuring U.S. access to future strategic and critical mineral and material supplies will require a long-term plan tailored for a specific mineral or material that considers its extraction, processing, and consumption system. 1/ Developing and implementing such a "systems basis" approach to resolving U.S. vulnerability problems will involve not only Federal agencies other than Interior, but also continuing long-range analyses and planning relating to a given strategic and critical nonfuel mineral or material.

In this report, we identify three actions we believe are needed in developing legislative and executive proposals to promote an adequate and stable supply of strategic and critical minerals and materials. The actions are (1) clearly defining the terms "strategic" and "critical" to focus attention on those markets where the United States is most vulnerable to supply disruptions or sharp price increases; (2) measuring the magnitude of the potential problem in a given market based on consistently applied criteria; and (3) assuring that the legislative, budgetary, and programmatic proposals required by Public Law 96-479 address not only long-term, national nonfuel minerals and materials goals, but also the long-term goals of other Federal policies.

1/For example, in a 1981 report, "Manganese Reserves and Resources of the World and Their Industrial Implications" (NMAB-374), the National Academy of Sciences' National Materials Advisory Board states that assuring U.S. access to future manganese supplies will require a long-term plan involving complex international, political, and economic strategies that can neither be devised nor carried out by the U.S. steel and ferromanganese industries alone. The report concluded that, since similar situations are being encountered in procuring other critical materials, a national minerals policy must recognize and resolve U.S. mineral dependence problems by considering a given mineral's "supply, processing and use chain."

OBJECTIVES, SCOPE, AND METHODOLOGY

The objective of our review was to evaluate strides that have been made in developing legislative, budgetary, and programmatic proposals to promote an adequate and stable supply of minerals and materials needed to maintain national security, economic well-being, and industrial production as required by Public Law 96-479. We then identified additional actions that should be taken in determining the need for and type of Federal intervention in a given strategic and critical nonfuel mineral or material market.

The methodology we employed was to analyze the results of over 30 analytical methodologies and vulnerability assessments and studies performed by us; Federal agencies, laboratories, committees, and commissions; State laboratories and universities; private corporations and consulting firms; the Congressional Research Service (CRS); and others. (See app. I.) They were supplemented by interviews with and analyses of documents provided by Federal officials, industry representatives, consulting firms, and others. Our review was performed in accordance with GAO's current "Standards for Audit of Governmental Organizations, Programs, Activities, and Functions."

Our evaluation was coordinated with CRS, which has issued several studies relating to strategic and critical minerals and materials. (See app. I.)

BACKGROUND

For some minerals and materials, the United States appears vulnerable to contingencies that might either seriously disrupt supplies or cause sharp increases in price. These contingencies include actions by foreign governments or cartels intended to disrupt supplies or raise prices, natural disasters or civil or military conflicts in producing areas, and generalized worldwide demand surges.

While it is generally accepted that the United States is and will continue to be import dependent on some minerals and materials deemed essential to an industralized economy, two very strong and opposed perceptions of the need for and type of Federal nonfuel minerals and materials policy have dominated informed thought. One is that a free market system, operated by private enterprise with minimal Federal Government interference, has and will continue to meet U.S. industrial needs. The other perceives a need for Federal intervention to guarantee an adequate flow of minerals and materials deemed critical to the U.S. economy or national priorities such as defense and energy. This latter perception, at least in the extreme, tends to promote a national goal of self-sufficiency.

A "Fortress America" would require the United States to not only become completely self-sufficient in minerals and raw materials but also to insist on retaining primary and secondary basic industrial manufacturing capacity. Those with views between these extremes tend to emphasize the need for advanced contingency planning or an early-warning system to reduce the potential effects of a supply disruption or sharp price increase by providing a cushion of time during which an orderly transition from the use of one mineral or material to another could occur.

Public Law 96-479 required the Executive Office of the President to submit a program plan and report to the Congress. According to the act, this plan was to include programmatic and budgetary proposals and organizational structures to provide, among other things, continuing long-range analyses of (1) materials use to meet national security, economic, industrial, and social needs; (2) the adequacy and stability of supplies; and (3) the industrial and economic implications of supply shortages or disruptions. These analyses were to be used, in part, to evaluate and justify the relative benefits and costs of legislative and executive actions intended to mitigate the adverse impacts of potential supply disruptions or sharp price increases in nonfuel mineral and material markets.

On May 15, 1981, the office of the Ranking Minority Member, Senate Committee on Energy and Natural Resources, asked us to evaluate the need for legislative and/or executive actions to help mitigate the adverse impact of potential future supply disruptions or sharp price increases in critical mineral markets. The results of our evaluation are to be made available to the 97th Congress for use in formulating minerals policy legislation and in evaluating the program plan required by Public Law 96-479.

Similarly, on April 7, 1981, and again on August 19, 1981, the Chairman, House Committee on Science and Technology, asked us to assist his committee in monitoring the performance of Federal agencies having responsibilities under Public Law 96-479 and in evaluating the reports that they are required to submit to the Congress. Two status reports (EMD-81-124, July 27, 1981, and EMD-82-27, Nov. 18, 1981) have been issued to the Chairman on executive branch implementation of the act.

This report is being provided to both requestors to assist them in evaluating the President's April 5, 1982, program plan required by Public Law 96-479 and in determining the need for further legislative and executive actions to promote an adequate and stable supply of strategic and critical minerals and materials.

THE TERMS "STRATEGIC" AND "CRITICAL" SHOULD BE CLEARLY DEFINED

Continuing long-range analyses and planning to assure the future availability of minerals and materials should begin with a clear definition of the terms "strategic" and "critical." However, there now exist widely divergent definitions of these two terms.

The most commonly used definition of potential availability problems is an estimated percentage of U.S. consumption that is satisfied by imported supplies. Using this definition, the United States appears vulnerable in at least 26 of the 45 nonfuel mineral markets deemed essential to an industrialized economy. However, Interior's Office of Minerals Policy and Research Analysis has found that:

> "Two factors in particular determine the criticality of a mineral to the United States: (1) the likelihood that the future supply of the particular mineral to the United States might be interrupted; and (2) the importance of the mineral to the functioning of the U.S. economy. However, the most commonly used indicator of potential mineral supply problems is an estimated percentage of U.S. mineral consumption satisfied by imported supplies. Such an indicator is overly simplistic and often misleading in that it fails to take into account the relative uncertainty in the future supply of a particular mineral or the relative importance of the mineral to the U.S. economy. Because it ignores the two primary determinants of mineral criticality, the 'imports market share' estimate provides little assistance to the policymaker in identifying which of the imported minerals are actually critical." 1/

Similarly, in a June 25, 1981, report entitled "Minerals Critical to Developing Future Energy Technologies, Their Availability, and Projected Demand" (EMD-81-104), we state that high U.S. import reliance is not synonomous with vulnerability and does not necessarily present a high risk to the U.S. economy or a national energy program.

1/Office of Minerals Policy and Research Analysis, Department of the Interior, "Developing a Critical Minerals Index: A Pilot Study," July 1979.

The Strategic and Critical Materials Stock Piling Revision Act of 1979 (P.L. 96-41, 50 U.S.C. 98 et seq.) states that:

> "The term 'strategic and critical materials' means materials that (A) would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency, and (B) are not found or produced in the United States in sufficient quantities to meet such need.
>
> "The term 'national emergency' means a general declaration of emergency with respect to the national defense made by the President or by the Congress."

The Federal Emergency Management Agency (FEMA) has clarified these terms in its operational definition used to formulate national stockpile policy and planning guidance. It defines strategic as the relative "availability" of a material and critical as its "essentiality." 1/

We believe that the two determinants of U.S. vulnerability identified by Interior as well as the operational definition used by FEMA to formulate national stockpile policy and planning guidance should be used as a basis for a clear definition of the terms strategic and critical. "Strategic" should relate to the probability of a supply disruption or sharp price increase in a given nonfuel mineral or material market and its expected duration, while "critical" should relate to the adverse impact that would occur if supplies are disrupted or prices are sharply increased. Clarifying these terms would reduce the number of markets deemed strategic and critical, thereby focusing attention on those where the United States is most vulnerable.

AN APPROACH SHOULD BE DEVELOPED TO MEASURE THE MAGNITUDE OF THE POTENTIAL PROBLEM

The consensus among most risk assessments we reviewed (see app. I) as well as our energy-critical and strategic analysis indicate that a clear definition of the terms strategic and critical would show that the United States is most vulnerable in about a dozen nonfuel mineral and material markets, including aluminum ores (bauxite), chromium, cobalt, columbium (niobium),

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1/According to a FEMA official, this definition derived from a January 30, 1940, report to the President by the Army and Navy Munitions Board entitled "Strategic and Critical Minerals."

gold, manganese, nickel, the platinum group metals, tantalum, tin, titanium, and tungsten. However, there is general disagreement on what the proper Federal role should be. This disagreement stems, in part, from the lack of an approach to measure the magnitude of the potential problem by quantifying the "degree" of U.S. vulnerability in a given market.

CRS has found that the role of minerals and materials in the economy and the flexibility of the United States to adapt to changes in their availability is "perhaps the primary factor in determining attitudes toward 'import vulnerability' * * *." 1/ However, experts cannot agree on their importance. Some point out that materials per se, and to a lesser degree minerals, represent only a small fraction of the U.S. gross national product and, consequently, that a slowdown or cessation of imports would not be disastrous for the economy. Others contend that a cessation of certain critical mineral and material imports could "create economic disruptions potentially even more devastating than any that might occur from a cutoff of petroleum." A more moderate view, held by many experts, is that the U.S. economy could indeed adapt to most supply disruptions but that, depending on the particular mineral or material involved, the time required for such adaptation could be lengthy, and some disruption could occur.

Definitive criteria should be established

The first step in measuring the magnitude of potential U.S. vulnerability in a given market is to establish definitive strategic and critical criteria. Our June 25, 1981, report as well as a January 11, 1982, report on national defense-related silver needs 2/ state that strategic factors such as (1) the political and economic stability of major foreign suppliers; (2) concentration of production and/or processing capacity in one or several foreign countries and their geographic proximity to the United States; and (3) political, military, and economic ties with the United States must be considered in estimating the probability of a supply disruption or sharp price increase and its expected duration.

1/Congressional Research Service, Library of Congress, "A Congressional Handbook on U.S. Materials Import Dependency/ Vulnerability," September 1981.

2/U.S. General Accounting Office, "National Defense-Related Silver Needs Should Be Reevaluated and Alternative Disposal Methods Explored," EMD-82-24, January 11, 1982.

Criticality factors such as (1) the cost of the potential loss to the U.S. economy and to national priorities such as defense and energy; (2) the availability of incidental, market-related incentives such as substitution, conservation, expanding domestic and foreign supplies, increasing recycling, and drawing down industry stocks to mitigate any adverse impact; and (3) the lead time associated with implementing the various mitigating alternatives should be considered in estimating the adverse impact that would occur if supplies are disrupted or prices are sharply increased.

Similarly, a December 1980 report on a CRS workshop on U.S. minerals and materials attended by experts on potential availability problems listed 16 criteria that could be quantified in determining the degree of U.S. import vulnerability. 1/ Some--such as the number of supply sources and their location, percentage of total U.S. consumption from overseas supply sources, and the extent of worldwide competition for dwindling supplies--deal with the relative strategic nature of a given nonfuel mineral or material. Other criteria--such as the degree of importance to the U.S. economy, need for the mineral or material by the military for national defense, the ease of substitution and recycling, the dollar amount used by the United States, and the time required for substitution or to expand supply sources--deal with their relative criticality.

In computing stockpile goals, FEMA relies on information from other Federal agencies to determine the "availability" and "essentiality" of a given material. For example, supply projections, performed primarily by commodity specialists within Interior's Bureau of Mines, are combined with judgmental reliability factors provided by the Departments of Defense and State to estimate the wartime "availability" of a given material. Defense also provides a war scenario hypothesized in terms of participants, war fronts, type of military action, and warning time to determine "essential" defense requirements.

Our June 25, 1981, report states that while supply disruptions or sharp price increases could occur in certain strategic and critical markets, opportunities appear available to mitigate most adverse impacts through incidental, market-related incentives. However, not all alternatives are available for a specific strategic and critical mineral, and the availability of many alternatives is uncertain due primarily to the lead time associated with their implementation. We conclude

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1/House Committee on Science and Technology, "Emerging Issues in Science and Technology: A Compilation of Reports on CRS Workshops," 96th Congress, December 1980.

that generalizations concerning the availability of nonfuel minerals are difficult, if not impossible, to make and that each strategic and critical mineral may have to be analyzed and evaluated on its own merits before comparative analysis is performed.

We believe that definitive criteria should be established for use in measuring the magnitude of the potential problem by quantifying the degree of U.S. vulnerability in a given strategic and critical nonfuel mineral or material market. Factors identified by us, CRS, FEMA, and others should be considered.

A quantitative methodology should be developed

Once definitive criteria have been established, a methodology should be developed to consistently apply the criteria to measure the magnitude or degree of U.S. vulnerability. We, Interior, and FEMA have developed analytical methodologies to estimate projected energy-related demand for nonfuel minerals, the economic benefits and costs of policy actions, and defense-related requirements during national emergencies, respectively. However, as noted by Interior's Office of Minerals Policy and Research Analysis in an August 1981 report, 1/ despite numerous studies, a basis for analysis of the "criticality" of specific materials and the elements of a national critical materials policy based on a sound analytical approach have not been formulated.

While it is virtually impossible to precisely predict the economic and political motivations of foreign countries, the Office of Minerals Policy and Research Analysis is attempting to develop a comprehensive policy analytical system and an overall analytical technique which would aid in estimating the criticality of a mineral or material and the effectiveness (including the economic benefits and costs) of policy actions. To date, the overall analytical framework has been completed for an evaluation of the relative criticality of cobalt and for estimating the economic benefits and costs of policy actions directed at the cobalt market using political assessment, cobalt market, and interindustry models. The analysis does not, however,

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1/Office of Minerals Policy and Research Analysis, Department of the Interior, "Cobalt: Effectiveness of Alternative U.S. Policies to Reduce the Costs of a Supply Disruption," August 1981.

measure the implications of any disruption on national priorities such as defense and energy nor does it analyze the qualitative changes in a product resulting from substitutions.

FEMA, on the other hand, has developed a methodology to determine how much of each of 93 strategic and critical materials should be stored in the National Defense Stockpile. The methodology estimates the requirements and supply of each material for the first 3 years of a war of indeterminate duration. A computer modeling methodology estimates wartime requirements for materials. Supply estimates, which are compared against these requirements to set stockpile goals, are calculated apart from the model using mostly manual techniques. We have found that this methodology is a "reasonable approach representing a variation of the generally accepted state of the art for this type of analysis." 1/

A similar methodology, developed jointly by us and the Lawrence Berkeley Laboratory, evaluates projected energy-related demand for nonfuel minerals. 2/ The methodology modifies and interlinks two accepted computer models to provide projected demand for 46 nonfuel mineral sectors in 5-year intervals to the year 2000 under technology scenarios used to formulate national energy policy. Projections of total U.S. and world primary demand, mine production capacity, and level of production for each mineral evaluated are estimated by Interior's Bureau of Mines using both statistical and contingency analyses. Supply projections are then combined with judgmental reliability factors and available risk assessments and studies to estimate the relative availability of a given mineral. The criticality or essentiality of a mineral for energy-related uses, including the availability of alternatives to mitigate the adverse impact of supply disruptions or sharp price increases, are calculated apart from the model using information obtained from Interior's Bureau of Mines and U.S. Geological Survey, the National Academy of Sciences, Department of Energy National Laboratories, major energy-related engineering and consulting firms, and others.

We believe that the magnitude of the potential problem should be measured by developing an approach to quantify the "degree" of U.S. vulnerability in a given nonfuel mineral or material market

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1/U.S. General Accounting Office, "National Defense Requirements for a Silver Stockpile," LCD-79-410, April 10, 1979.

2/U.S. General Accounting Office, "Minerals Critical to Developing Future Energy Technologies, Their Availability, and Projected Demand," EMD-81-104, June 25, 1981.

using consistently applied definitive strategic and critical criteria. The methodology could build on the analytical techniques developed by us, Interior, FEMA, and others. The degree of U.S. vulnerability could then be used to determine the need for Federal intervention.

SHORT-TERM ACTIONS SHOULD ADDRESS LONG-TERM GOALS

If Federal intervention in individual strategic and critical nonfuel mineral and material markets is deemed necessary based on a consistent approach that quantifies the degree of U.S. vulnerability, comparative analyses among these minerals and materials should be performed, and the benefits and costs of additional mitigating alternatives weighed. Legislative, budgetary, and programmatic proposals developed to address significant problems identified should articulate how the short-term action (1) will promote long-term, national nonfuel minerals and materials goals and (2) relates to the long-term goals of other Federal policies.

Short-term actions should promote long-term minerals and materials goals

The coherent application of a nonfuel minerals and materials policy must incorporate the long-term goals of Public Law 96-479 to promote an adequate and stable supply of materials necessary to maintain national security, economic well-being, and industrial production. These goals should be coupled with consistent policy actions derived from short-term needs. Moreover, issues or problems must be identified and discussed in enough detail to provide an agenda for action.

For example, if Federal intervention is deemed necessary to assure the adequate and stable supply of cobalt and if the degree of U.S. vulnerability in this market is comparatively greater than in other strategic and critical mineral and material markets, the benefits and costs associated with additional mitigating alternatives should be weighed. These alternatives include stockpiling, increased domestic production, and substitution research and development.

National Defense Stockpile goals represent the estimated material requirements for the first 3 years of a conventional war, above those which could be expected to be available from domestic production and reliable imports. Consequently, each annual ton of new domestic production reduces stockpile requirements by 3 tons for as long as productive capacity is available. Similarly, research to develop technologies that are less mineral intensive or utilize different minerals or to substitute other

minerals in applications where cost and preferred use are the key criteria could reduce U.S. vulnerability by reducing domestic demand. Therefore, an agenda for action to reduce U.S. vulnerability to disruptions in the supply of cobalt or sharp increases in its price should include a benefit/cost analysis of these alternatives.

Almost 40 million pounds of cobalt are needed to meet the stockpile goal. Thus, there is a short-term need to either acquire this mineral or to reduce the goal level by fostering domestic production and/or reducing consumption. However, the United States has only limited marginally economic cobalt reserves.

Title III of the Defense Production Act, as amended, (50 U.S.C. App. 2061 et seq.), authorizes loans, loan guarantees, and commitments to purchase (price supports) to private industry for the exploration, development, and mining of strategic and critical metals and minerals. Over the past several years, FEMA officials have proposed that price supports be authorized to develop new domestic cobalt production, thus reducing the stockpile goal. However, it is doubtful that the domestically mined cobalt could be sold at the current market price and, consequently, it would have to be acquired for the stockpile regardless of the goal level.

The producer price of cobalt in the world market reached $25 per pound in 1979. However, by November 1981, its market price had dropped to $17 per pound with some transactions below $10 per pound, and its price outlook remains weak. Officials of the Anschutz Mining Corporation are reportedly seeking a Federal price support of $28.50 per pound to open their Fredericktown, Missouri, cobalt mine. Similarly, Noranda Mining, Inc., officials believe that a $25 per pound price support would be attractive to open their Blackbird, Idaho, cobalt mine. At the same time, the General Services Administration is acquiring 5.2 million pounds of cobalt from Zaire at $15 per pound. If the Federal Government is required to purchase 40 million pounds of cobalt from domestic producers at $25 per pound instead of from foreign producers at $15 per pound, increased costs would be $400 million. Thus, domestic mining of this mineral may only be obtained at great cost.

Furthermore, Federal incentives to foster domestic mining of limited reserves could result in the unwarranted depletion of domestic supplies that might better be saved for future use. For example, limited marginally economic domestic reserves of cobalt have an estimated mine life of about 10 years. In the absence of technological breakthroughs, substantial increases in producer prices, and/or new domestic ore discoveries, domestic

mining of cobalt now may increase U.S. long-term vulnerability to supply disruptions or sharp price increases.

We believe that any budgetary or programmatic proposal to foster domestic mining of a strategic and critical mineral or material should articulate how the short-term action will promote long-term national goals, including maintaining national security and economic well-being. This would include weighing the benefits and costs of domestic mining against other mitigating alternatives, including the development of substitutes authorized under title III as well as under section 8 of the Strategic and Critical Materials Stock Piling Act, as amended.

The long-term goals of other Federal policies should be considered

Public Law 96-479 also recognizes that development of a formal, operational statement of U.S. policy on nonfuel minerals and materials must establish a long-term balance among resource protection, energy use, a healthy environment, natural resources conservation, and social needs. Tradeoffs between these policies and nonfuel minerals and materials should be weighed so that decisions can be made in full recognition of the possible consequences.

For example, mining marginally economic reserves of cobalt may not only be obtained at great economic costs but at great environmental costs as well. The Blackbird orebody is located in a cobalt-sulfur-arsenic zone in the Salmon National Forest. Former poor mining practices will require an environmental cleanup, and adherence to environmental regulations will require close control of the tailings (waste left in processing). Environmental control costs are estimated to be about $3 per pound, and Noranda is considering refining the ore overseas. However, if domestic producers commit their resources to extracting the mineral but choose to have it refined overseas, U.S. strategic supply vulnerabilities may not be reduced.

We believe that budgetary and programmatic proposals to promote an adequate and stable supply of strategic and critical minerals and materials should articulate how the short-term action relates to the long-term goals of other Federal policies.

CONCLUSIONS

Public Law 96-479 gives high priority to the issue of strategic and critical nonfuel minerals and materials. Yet, the President's April 5, 1982, program plan does not adequately

address the fundamental, rudimentary issues of (1) what constitutes a strategic and critical mineral or material; (2) what is the magnitude of potential U.S. vulnerability in a given nonfuel mineral or material market; and (3) what is the proper Federal role, including the benefits and costs associated with various mitigating alternatives. Unless these issues are resolved, a coherent plan to reduce U.S. minerals and materials vulnerability may be difficult, if not impossible, to implement, and the limited Federal funds available may not be expended in the most cost-effective manner.

Assuring U.S. access to future strategic and critical minerals and materials will require a long-term plan tailored for a specific mineral or material that considers its extraction, processing, and consumption system. To accomplish this "systems basis" approach, the terms "strategic" and "critical" must first be clearly defined. "Strategic" should relate to the probability of a supply disruption or sharp price increase in a given nonfuel mineral or material market and its expected duration, while "critical" should relate to the adverse impact that would occur if supplies are disrupted or prices are sharply increased. Clarifying these terms would reduce the number of markets deemed strategic and critical, thereby focusing attention on those where the United States is most vulnerable.

An approach should then be developed to measure the magnitude of the potential problem by quantifying the "degree" of U.S. vulnerability in a given market. This would include establishing definitive strategic and critical criteria and developing a methodology for their consistent application. Factors identified by us, CRS, FEMA, and others should be considered in establishing the criteria, while the methodology could build on existing analytical techniques developed by us, Interior, FEMA, and others. The degree of U.S. vulnerability in a strategic and critical nonfuel mineral or material market can then be used to determine the need for Federal intervention.

If Federal intervention is deemed necessary, comparative analyses among minerals and materials should be performed, and the benefits and costs of additional mitigating alternatives weighed. Legislative, budgetary, and programmatic proposals developed to address significant problems identified should articulate how the short-term action (1) will promote long-term, national nonfuel minerals and materials goals and (2) relates to the long-term goals of other Federal policies.

RECOMMENDATIONS

We recommend that you, as Chairman pro tem of the Cabinet Council on Natural Resources and the Environment:

--Define the term "strategic" to relate to the probability of a supply disruption or sharp price increase in a given nonfuel mineral or material market and its expected duration and the term "critical" to relate to the adverse impact that would occur if supplies are disrupted or prices are sharply increased.

--Develop an approach to measure the magnitude of the potential problem by quantifying the "degree" of U.S. vulnerability in a given market. This would include establishing definitive strategic and critical criteria considering factors identified by us, CRS, FEMA, and others, and developing a methodology for their consistent application. The methodology could build on existing analytical techniques developed by us, Interior, FEMA, and others.

--Assure that legislative, budgetary, and programmatic proposals articulate how each short-term action (1) will promote long-term, national nonfuel minerals and materials goals and (2) relates to the long-term goals of other Federal policies.

As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of the Federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the appropriate congressional committees to assist them in evaluating the President's April 5, 1982, program plan required by Public

Law 96-479. We are also sending copies to your Inspector General; Deputy Assistant Secretary, Energy and Minerals; and other interested officials and will make additional copies available upon request.

Sincerely yours,

for J. Dexter Peach
Director

BEST DOCUMENT AVAILABLE

ANALYTICAL METHODOLOGIES, RISK ASSESSMENTS, AND STUDIES REVIEWED BY GAO

DEPARTMENT OF THE INTERIOR:

--Demand and Supply of Nonfuel Minerals and Materials for the United States Energy Industry, 1975-90--A Preliminary Report. U.S. Geological Survey, Professional Paper 1006-A, B. 1976.

--Developing a Critical Minerals Index: A Pilot Study. Office of Minerals Policy and Research Analysis, July 1979.

--Cobalt: Effectiveness of Alternative U.S. Policies to Reduce the Costs of a Supply Disruption. Office of Minerals Policy and Research Analysis, August 1981.

DEPARTMENT OF COMMERCE:

--Policy Implications of Producer Country Supply Restrictions: Overview and Summary. Charles River Associates, Report No. 20, December 1976.

ENVIRONMENTAL PROTECTION AGENCY:

--Lead, Copper and Zinc Price Forecasts to 1987. Volumes I and II, Charles River Associates, June 1980.

GENERAL SERVICES ADMINISTRATION:

--Cobalt: An Industry Analysis. Charles River Associates, 1971.

--Tungsten: An Industry Analysis. Charles River Associates, 1971.

NATIONAL SCIENCE FOUNDATION:

--Materials Availability in a Changing World. October 1, 1975.

DEPARTMENT OF ENERGY:

--Future U.S. Energy Supply: Constraints by Nonfuel Mineral Resources. H. E. Goeller, Oak Ridge National Laboratory, December 1980.

--Raw Material Requirements for Energy Development Programs. Bechtel Corporation, January 1978.

APPENDIX I

--Achieving a Production Goal of 1 Million B/D of Coal Liquids by 1990. TRW Energy Systems Planning Division, March 14, 1980.

--Silicon Materials Outlook Study for 1980-85 Calendar Years. Jet Propulsion Laboratory, California Institute of Technology, November 1, 1979.

--A Methodology for Identifying Material Constraints on Implementation of Solar Technologies. Battelle Pacific Northwest Laboratory, March 1978.

--A Methodology for Assessing Systems Materials Requirements. National Aeronautics and Space Administration, January 1980.

--Materials Availability for Fusion Power Plants. Battelle Pacific Northwest Laboratory, September 1976.

--A Federal Look at the Needs for Energy-Related Materials Research and Development. Committee on Materials (COMAT), Federal Council for Science and Technology, Vol. 2, 1976.

--U.S. Energy Supply Prospects to 2010. Committee on Nuclear and Alternative Energy Systems (CONAES), National Research Council, 1979.

--Study of Materials Implications of Fossil Energy. Oak Ridge National Laboratory, 1980.

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